2011

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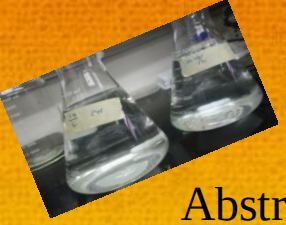

Effects of 2, 4-D on *Zea maize* Physiology

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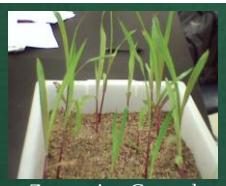
Abstract

Growth rate, fluorescence and stomatal conductance in zea maize was examined to determine the effects of artificial auxin, 2-4-d, on common crop plants. We measured fluorescence, growth rate, and stomatal conductance. Low concentrations of 2, 4-D increased light-adapted fluorescence, anthocyanin levels and height of zea maize. A high concentration of 2, 4-D increased anthocyanin levels, but also caused decreased fluorescence and height and caused spindliness to occur. It appears 2, 4-D is only beneficial to monocot crop plants in low quantities. We cannot accurately comment on the accuracy of our data, however, due to several potential sources of error.

Introduction

2, 4-dichlorophenoxyacetic acid, more commonly known as 2, 4-D, has become one of the most widely used commericial herbacides available since it's introduction in 1942. Studies now show correlations between exposure to 2, 4D and problems such as Non-Hodgkin's Lymphoma (Zahm et all, 1990), a reduced reproductive ability (Lerda and Rizzi, 1991) and environmental stress (Asmussen et all, 1976.) 2, 4-D is currently being investigated to determine whether it should be continually used for weed control.

The purpose of this experiment was to determine the effects of 2,4D on crop plants. Acting as an artificial auxin, 2, 4-D causes rapid elongation in broadleaf plants. The plant quickly becomes tall enough to make transportation impossible and dies. This particular effect, however, is seen only in broadleaf plants such as dandelions and does not affect narrow leaf plants, such as the monocot *Zea maize*. We wondered if other functions would be affected and hypothesized that 2,4-D would inhibit growth, and fluorescence but would increase transpiration in *Zea maize*. This was tested by administering 2 concentrations of 2, 4-D to stressed plants and measuring these rates before and after administration.



Zea maize: Control

Zea maize: Low [2-4-D]

Zea maize: High [2-4-D]

Procedure

Twenty *Zea maize* seeds were planted 4 cm deep in 30 cm square bins filled with vermiculite and water. Each bin was labeled and placed in a growth chamber set at 24.4°C. The plants were watered with 1 L of water per bin every three to four days. On Day 15 and 17, two bins were treated with 2, 4-dichlorophenoxyacetic acid.

Concentrations of 2,4 dichlorophenoxyacetic acid prepared on stir plate:

- 1g/L: 0.5040 grams of 2,4-D crystal, 0.5 L of deionized water, 3 drops of Tween 20 dispersant, and 10 mL of ethanol
- 50 mg/L : same components with .0275 grams of 2,4-D.

1 mL of the 1g/L solution was applied to the soil at the base of each shoot in Box 2. In Box 3, each shoot was likewise treated 0.5g/L solution. This treatment was repeated two days later, to ensure full exposure despite an overflow of water from the day of the first treatment.

On Day 20, 2 drops of Miracle Grow were added to each tray.

Measurements Taken:

- Every 3-4 days: shoot height in centimeters
- Day 14 and 29: Light and Dark Adapted Flouresence (with the Opti-Science OS1-FL Pulse Modulated Flourometer, Stomatal Conductance with Decagon SC-1 Leaf Porometer. (abaxial side of most mature leaves)
- Day 29 only: shoot vertical angle with protractor

Discussion

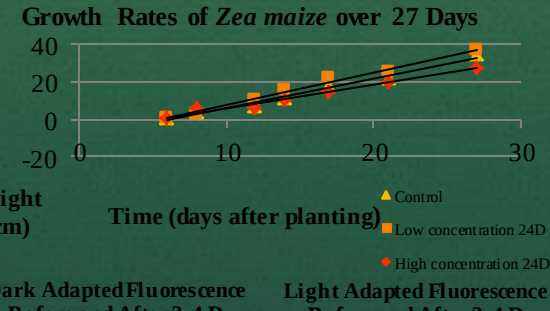
Given that 2, 4 D is a plant growth regulator, we expected to see a plant height significantly effected by the addition of 2, 4 D. However, up until Day 21, the control and both experimental groups grew at approximately the same rate. By day 28, the higher concentration experimental group had slowed in growth compared to the control group, but this is probably because by that point, the plants were unhealthy overall.

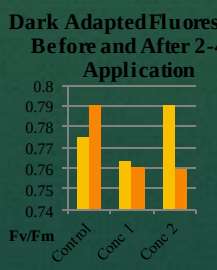
On the other hand, senescence did correlated with the concentration of 2, 4 D. While all three groups of seedlings displayed anthocyanins because of nutrient stress, the treated seedlings allowed their lower leaves to senesce. This tendency was more evident in the seedlings treated with a higher concentration than those with a lower concentration, suggesting that 2, 4 D inhibits a plant's ability to deal with nutrient stress.

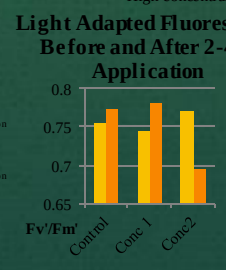
Spindliness was also highly correlated with the addition of 2, 4 D. Many of the treated plants were bent over at the base even though the stems remained perfectly straight. None of the plants in the control group bent over more than 10 degrees from vertical, while in the high concentration treated group, one third of the seedlings fell so far that they were supported by other plants or the edge of the container that they were growing in. The lower concentration treated plants displayed spindlyness to a lesser extent. The reason for this is unknown. Perhaps 2, 4 D has some detrimental effect of prop roots, causing them to loose turgor, weaken, or grow irregularly.

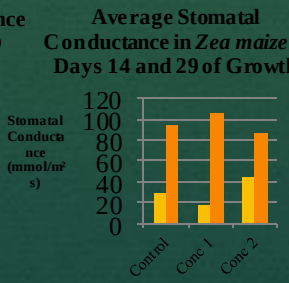
Unfortunately, the relationship between photosynthesis and 2, 4 D was unclear. This could be because it was difficult to control leaf age went taking flourometer and porometer measurements. Because the variation due to leave age may have been larger than the variation due to the addition of 2, 4 D, our data on these aspects may be meaningless.

Results









Conclusions

- Stomatal conductance increased with both concentrations of 2, 4-D.
- Height increased with a lower concentration of 2, 4-D but decreased when a higher concentration was administered.
- Fluorescence in dark adapted plants was not affected by lower concentrations of 2, 4-D but decreased with high concentrations.
- Light adapted flurorescence increased with lower concentrations and increased with higher concentrations of 2, 4-D.
- Both plants treated with 2, 4-D displayed greater spindliness and higher levels of anthocyanins then the control.

Literature Cited

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Acknowledgements

We'd like to thank Dr. Stephen Davis, Caitlin Ishibashi, and Andrea Lim for their advice and assistance throughout our experiment. We'd also like to thank Pepperdine University for the use of their lab facilities and equipment that made this study possible.